

البرنامج الوطني لتطوير قطاع
الثروة الحيوانية والسمكية
NATIONAL LIVESTOCK & FISHERIES D. P.

Next level diagnostics

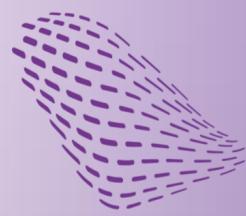
Dr. Sulaiman Alaje

&

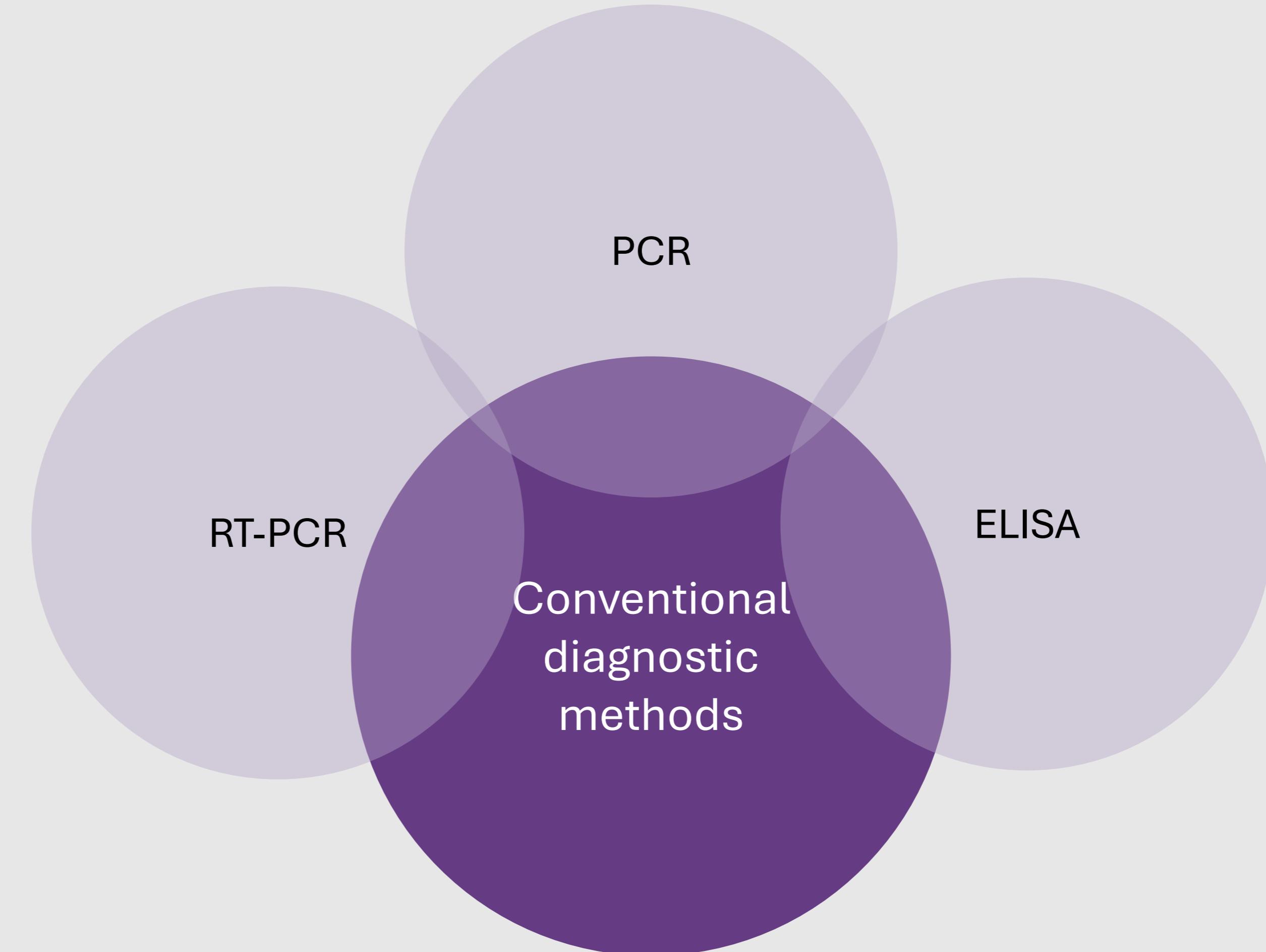
Dr. Hatim Almutairi

December 2025





Conventional diagnostic methods



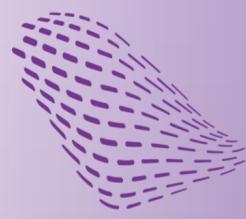


Conventional diagnostic methods

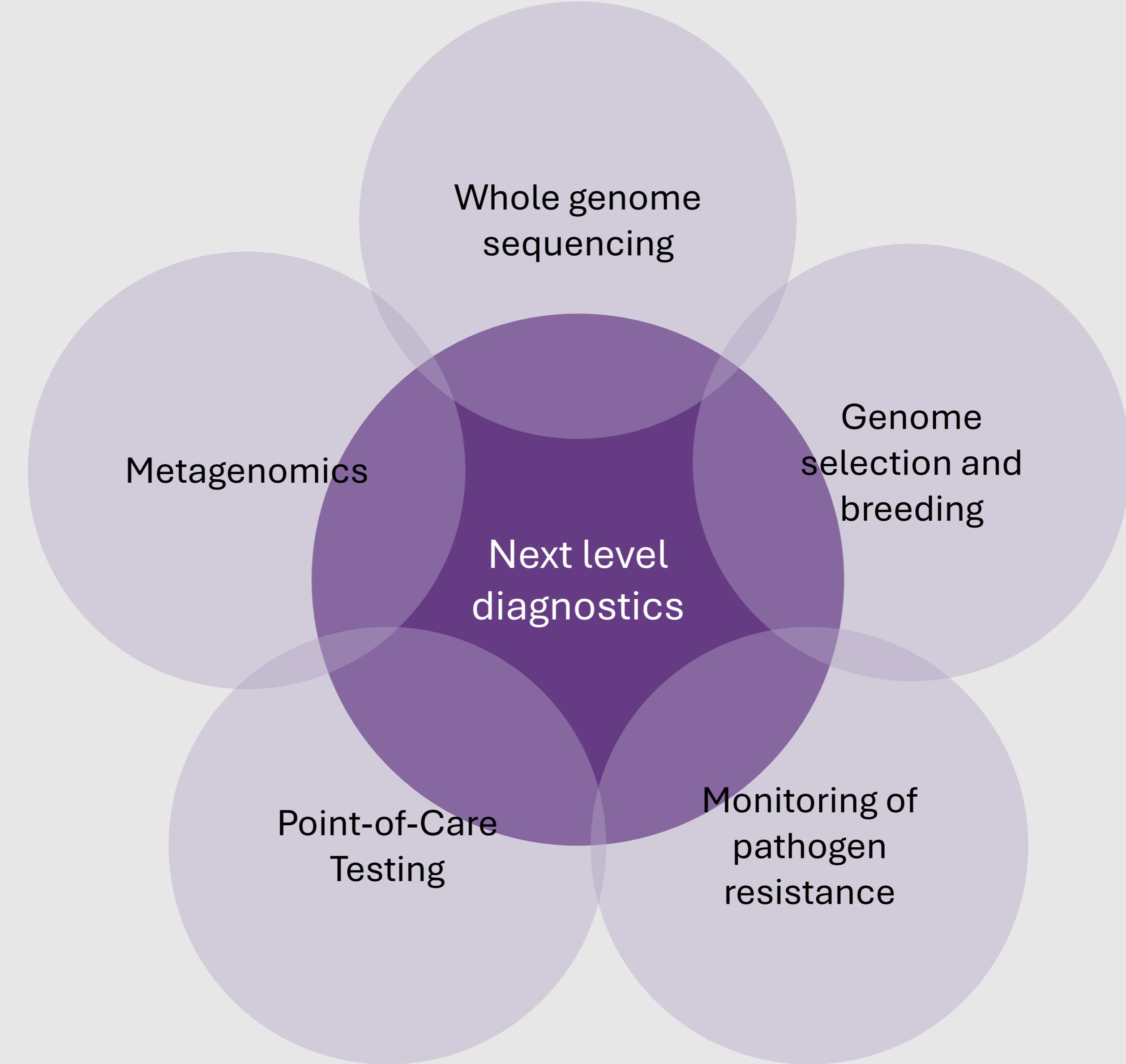


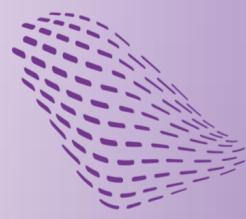
PCR, RT-PCR and ELISA

- **Require specialized labs.**
- **Require prior knowledge of the target.**
- **Limited number of pathogen detections at the same time.**
- **Require expensive equipment.**

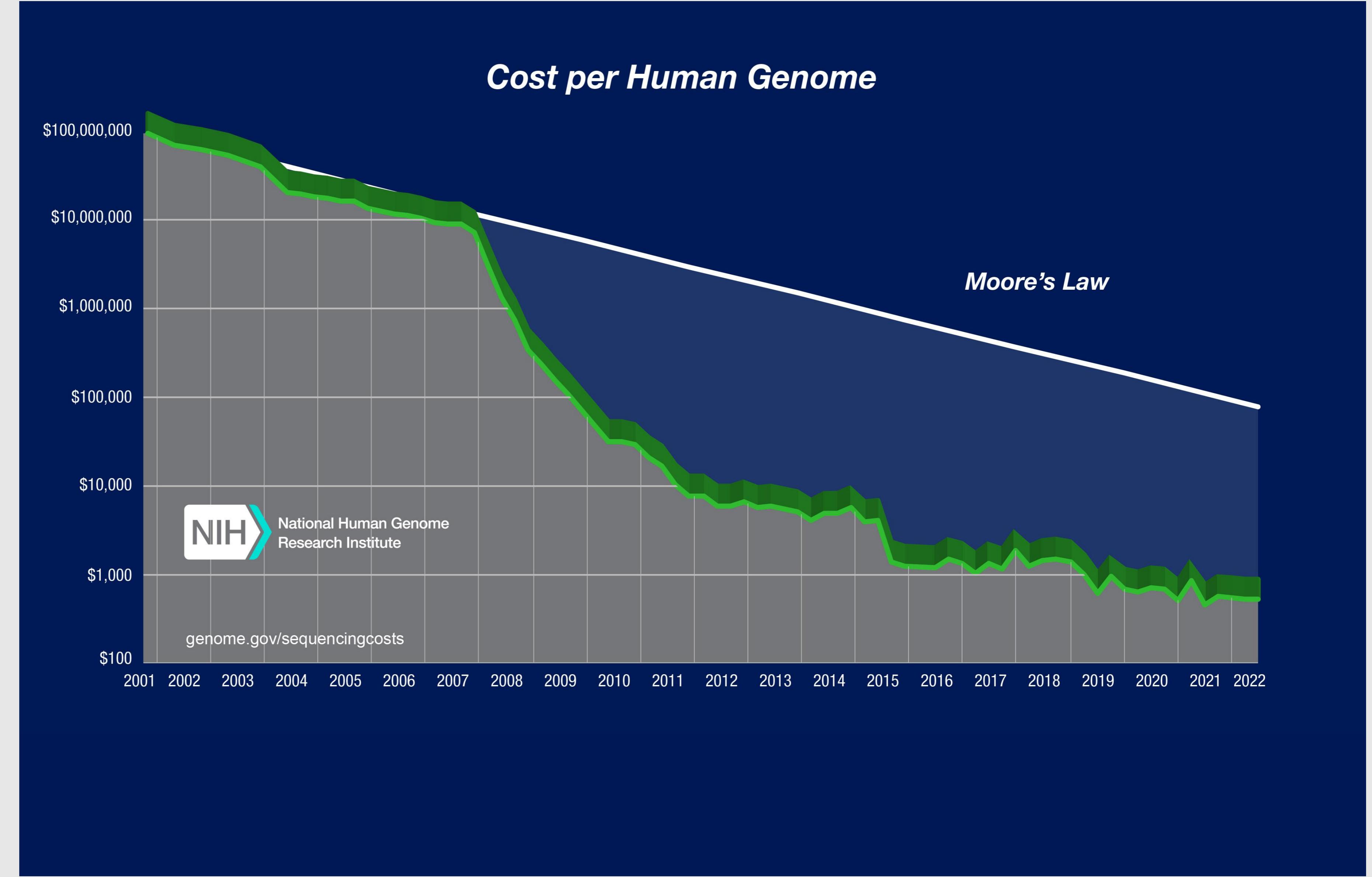


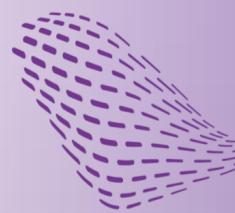
Next level diagnostics





Genome
sequencing costs
continue to decline
rapidly

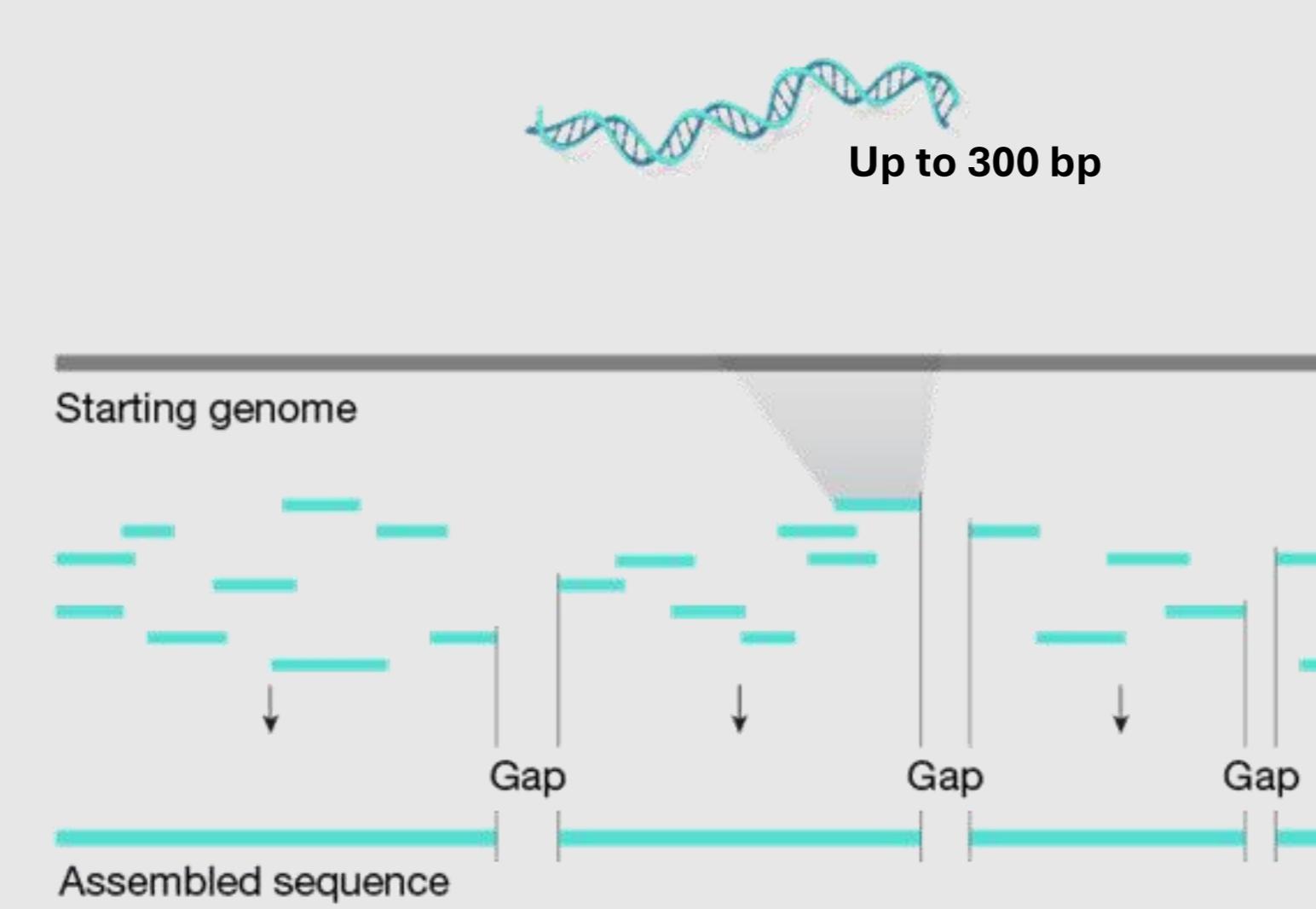




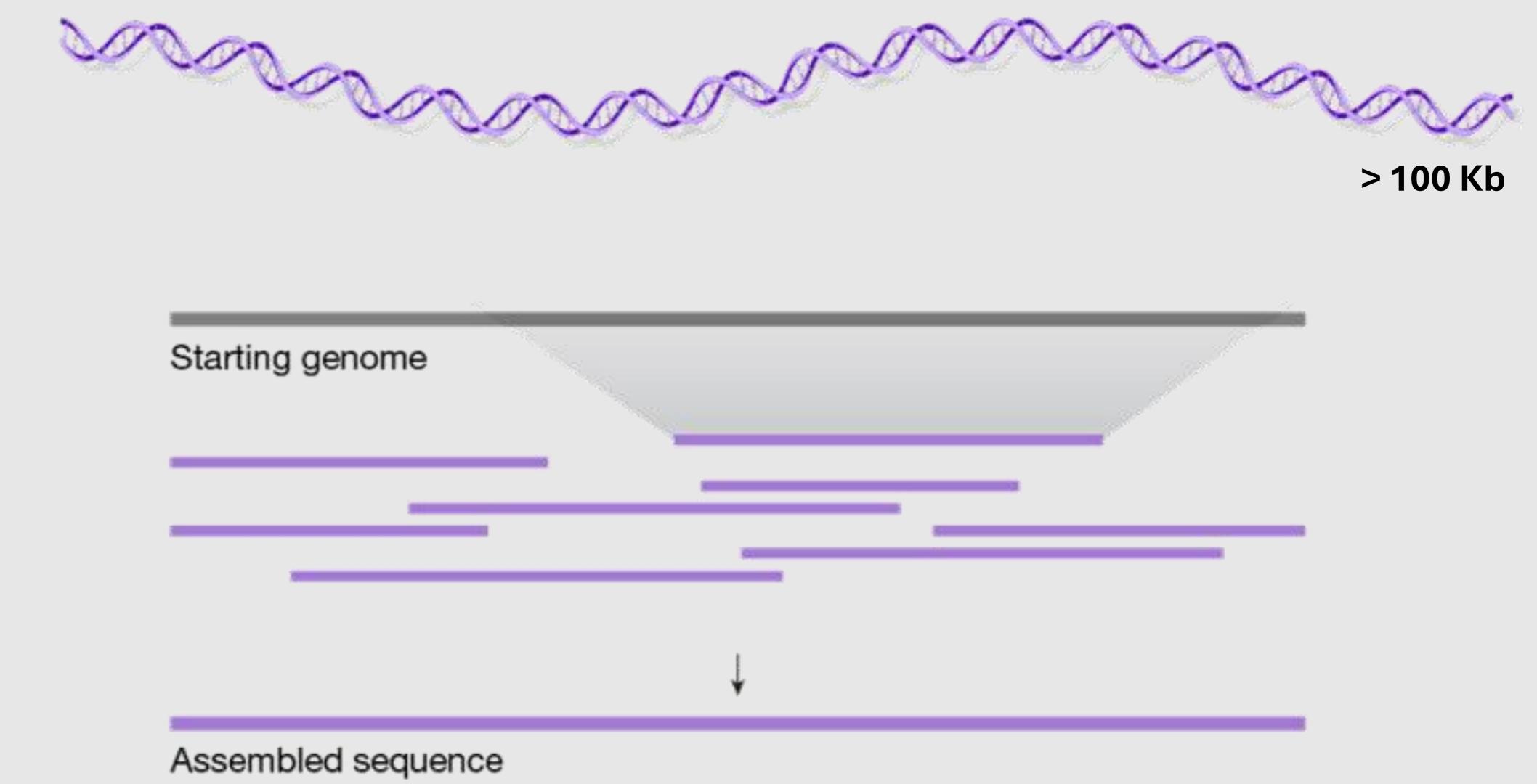
Whole genome sequencing

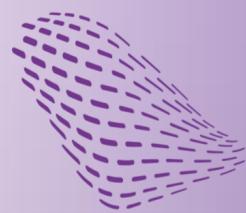


Short-read DNA sequencing



Long-read DNA sequencing





Telomere-to-Telomere (T2T) Complete Genome



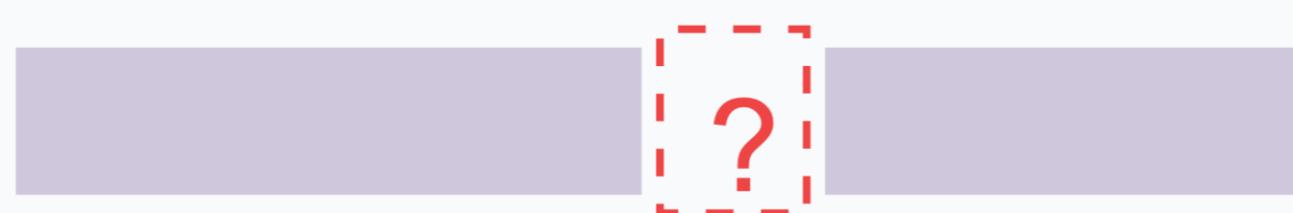
✗ Old Genome Assembly (with gaps)



Chromosome - 1 Missing %8~ of sequence



Chromosome 2 - Gaps in critical regions



Chromosome 3 - Unknown segments

⚠ The Problem:

- Missing important genes in gap regions
- Can't design accurate SNP markers
- Incomplete trait predictions
- Lost breeding opportunities

✓ T2T Complete Genome



Telomere

Chromosome %100 - 1 Complete



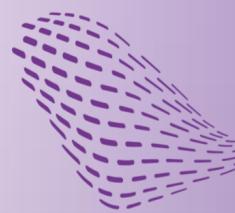
Chromosome 2 - End-to-End



Chromosome 3 - No Missing Data

✨ The Solution:

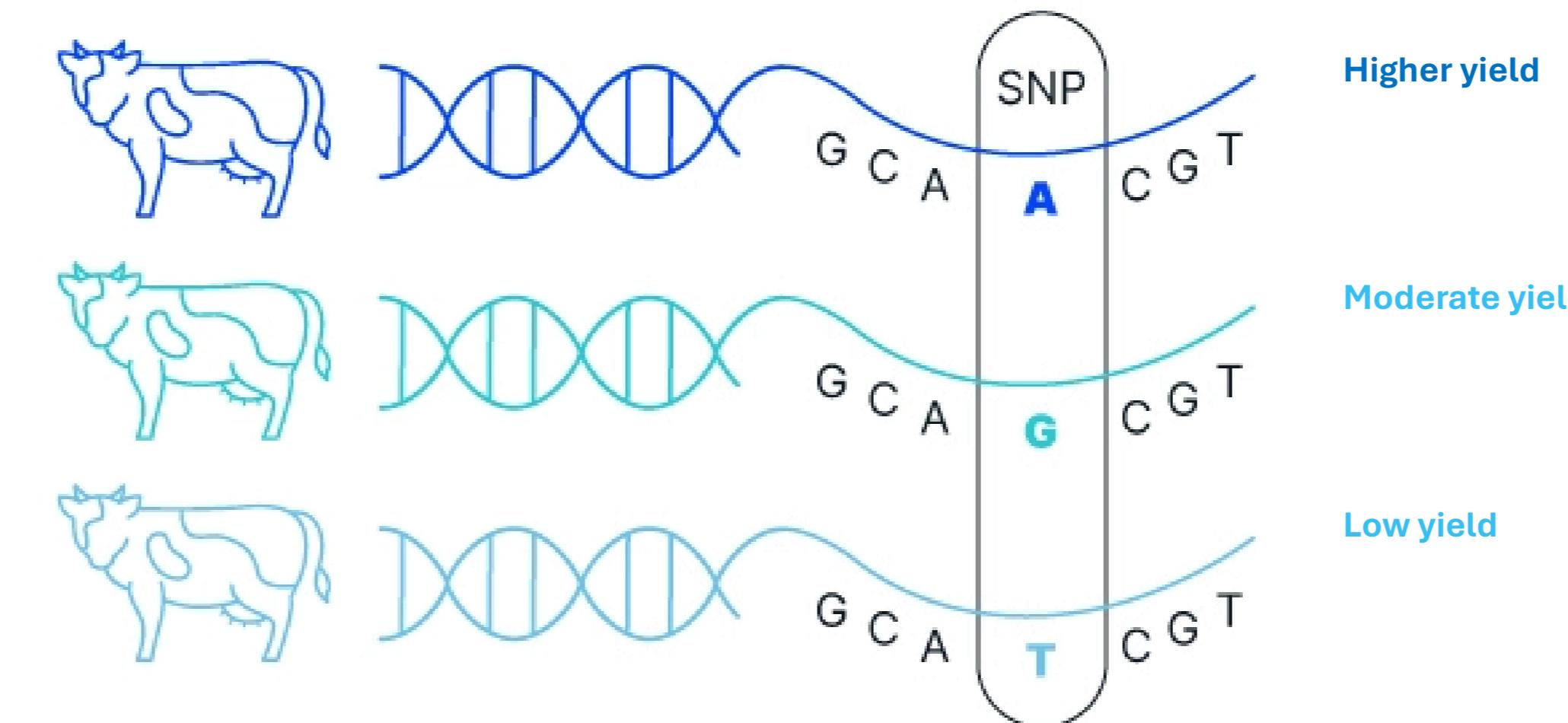
- Complete genetic blueprint end to end
- All genes discovered and mapped
- Accurate SNP chip design possible
- Better breeding decisions



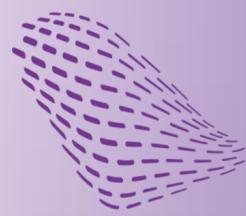
Genotyping



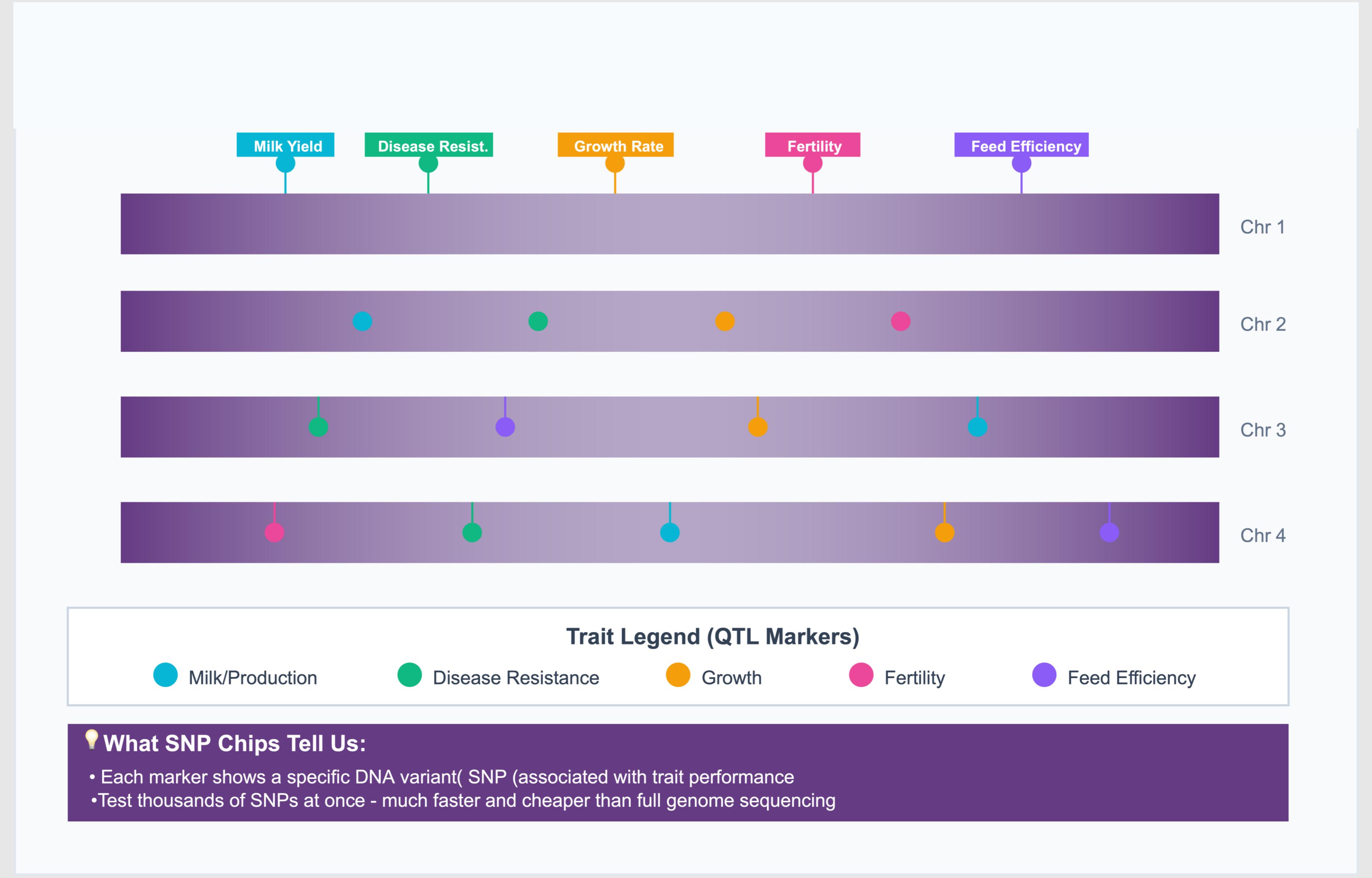
Genotyping analyses an animal's DNA to reveal specific genetic variations, effectively identifying the markers linked to traits that drive health and productivity.

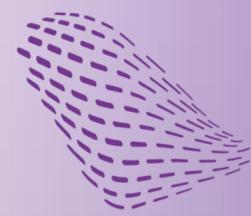


Understanding genetic variation between individuals drives decision-making in breeding programs.



Genotyping: SNP array



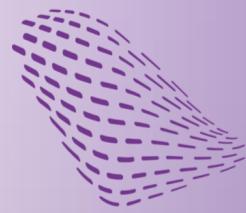


Genotyping



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Genotyping



Genotyping provides significant advantages for farmers and the livestock industry:

Identifying animals with superior genetic merit for desired traits:

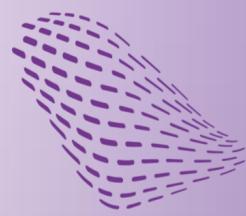
(e.g., higher milk yield, feed efficiency) and use them for breeding programs.

Identify genetic resistance to diseases or carriers of harmful genetic defects:

breeders to avoid high-risk matings and promote healthier herds.

Accelerating Genetic Gain

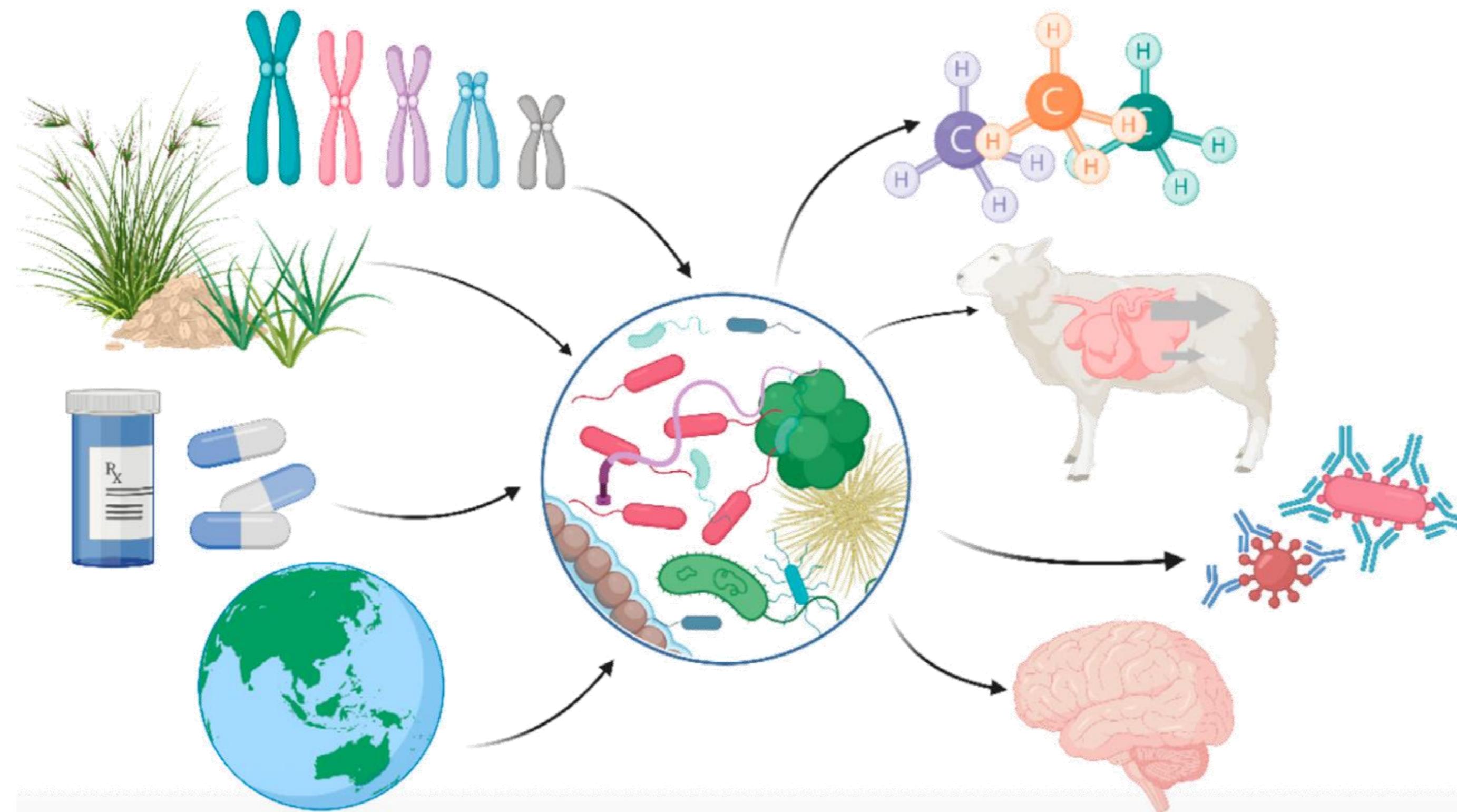
and shortening generation intervals and speeding up overall genetic improvement compared to traditional methods.



Metagenomics

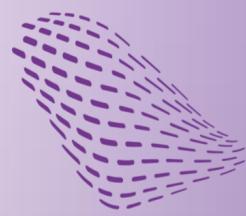


Microbiome is influenced by
a range of factors



Metagenomics is the collection and analysis of microbiome which is a community of all microorganisms in a particular environment.

Microbiome is thought to
influence several phenotypes

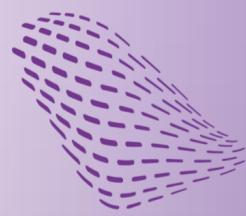


Metagenomics



Microorganism detection...Multiple detections at ONCE



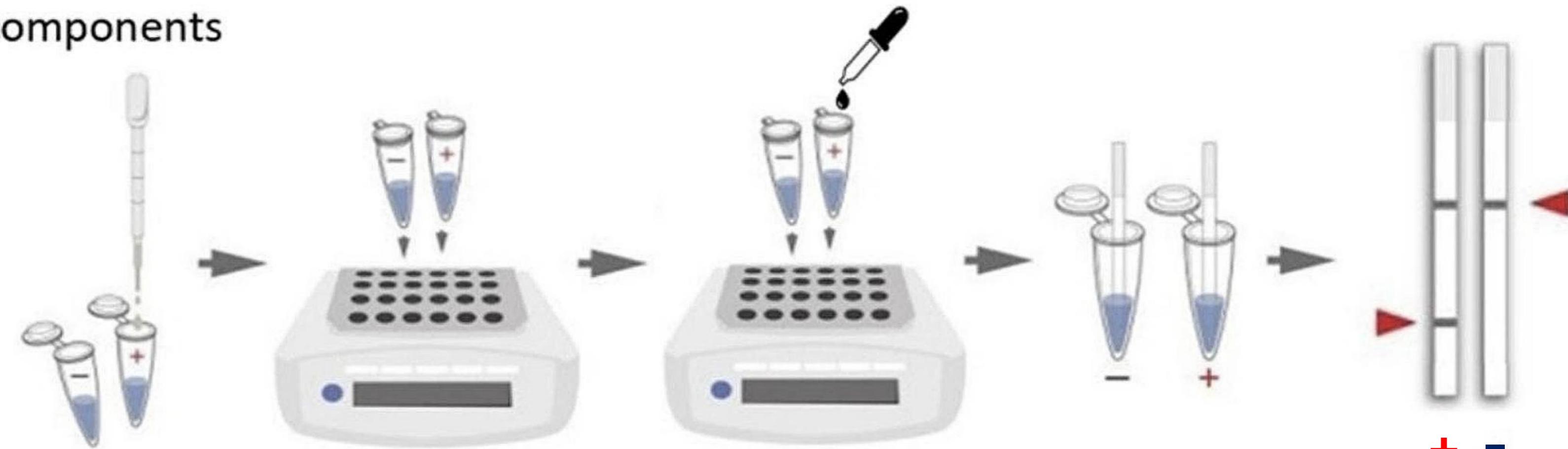


Point-of-Care Testing

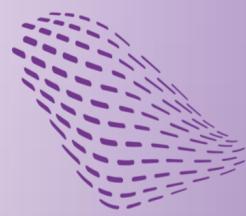


LAMP and CRISPR-based lateral flow assay.

1. Add sample DNA into reaction components
2. Heat reaction for 20 mins at 63°C
3. Add buffer CRISPR and heat for 40 mins at 42°C
4. Dip detection strip into reaction
5. Readout the results



Get the results within 60 min

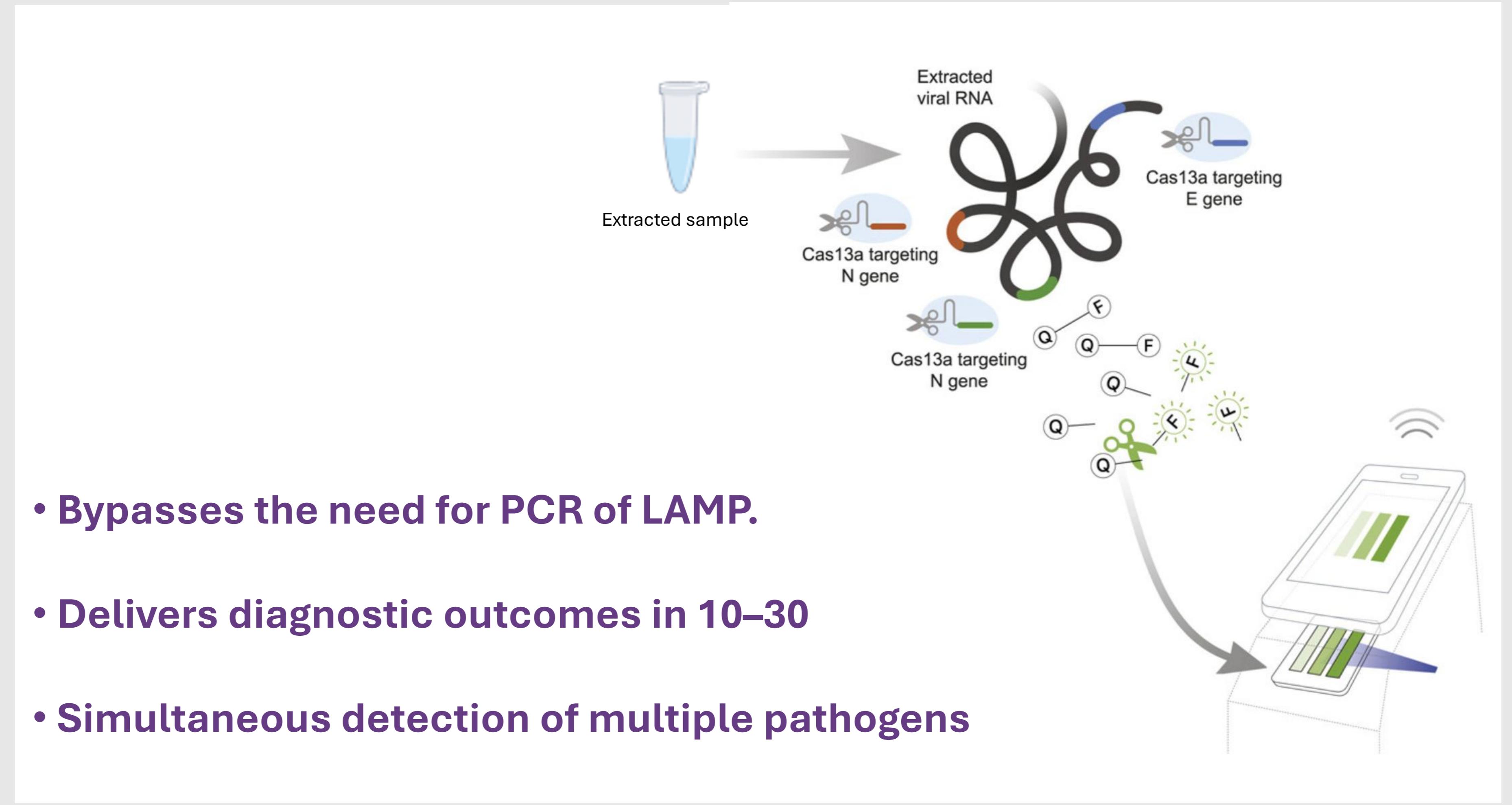


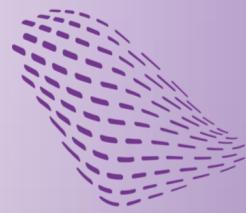
Point-of-Care Testing



Next level diagnostics

Amplification-free CRISPR detection.





Monitoring of pathogen resistance



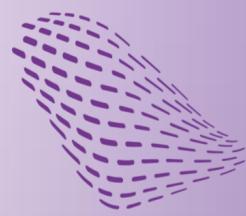
Next level diagnostics

Classical cultural method

- Tests pathogen independently.
- Tests gene by gene.
- only tells if a pathogen is resistant.

Whole Genome Sequencing

- Simultaneously sequences thousands of pathogen samples in a single run.
- Scans the complete collection of resistance genes in a bacteria.
- Detects resistance before treatment fails.
- Identifies novel mutations missed by standard tests.



Monitoring of pathogen resistance



Active Genomic Surveillance



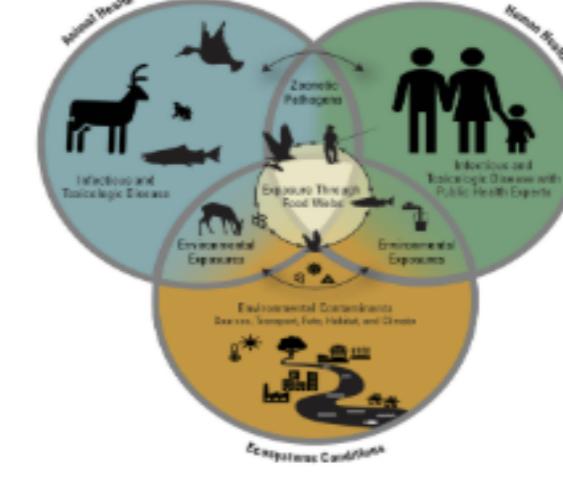
Routine Sampling

Proactively collecting samples from healthy and sick herds to detect "silent" resistance reservoirs before they spread.



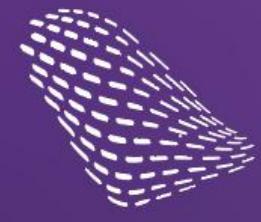
Digital Tracking

Mapping resistance hotspots in real-time. This "digital epidemiology" reveals how superbugs move between regions.



One Health

Monitoring the flow of resistance genes between animals, humans, and the environment to prevent spillover events and protect public health.



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Thank you

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